

1 2. (Unamended) The method of claim 1, wherein the step of calculating
2 comprises:
3 identifying parameterized geometric primitives in the space;
4 determining the elements of the primitives, wherein an element is a spatial structure
5 projectable onto the image;
6 mapping features of the image to the elements to form correspondences; and
7 solving for an objective function that minimizes an aggregate error between features of the
8 image and projections of elements onto the image.

Please delete claims 3-12 and enter the following claims for examination:

1 13. A method for generating remote presentations of products in situ for a user
2 comprising the steps of:
3 a) prompting the user to acquire a digital image of a space in which a product is to be
4 viewed in context;
5 b) accepting a product representation representing a product for which a three-dimensional
6 geometric model exists or can be created;
7 c) determining at least one dimension reference, wherein a dimension reference is a
8 measurement of a distance in the space corresponding to a separation of two points on
9 the digital image;
10 d) calculating, from the image, the at least one dimension reference and reference
11 information, camera parameters for a camera in the space from which the image was
12 captured, wherein the camera parameters include at least a camera position and a focal
13 length;
14 e) accepting an input of a product location, the product location being a location in the
15 space where the product is to be displayed in situ;
16 f) transforming the geometric model of the product based on at least the camera position
17 and the product location to form a transformed geometric model; and

18 g) combining the transformed geometric model and the digital image to form a modified
19 image of the space where the modified image has been modified to show the
20 identified product in situ in the image with a proper proportion and perspective.

1 14. The method of claim 13, wherein the step of accepting a product
2 representation comprises the steps of:
3 prompting the user to identify a product of interest from a set of products;
4 searching a collection of product representations to locate a member of the collection that
5 matches the product identified by the user; and
6 accepting the matching product representation.

1 15. The method of claim 14, further comprising a step of repeating steps b), e)
2 and f) for second and subsequent selected products.

1 16. The method of claim 13, wherein the step of accepting a product
2 representation includes a prior step of prompting the user to acquire a three-dimensional
3 geometric model for a product of interest to the user.

1 17. The method of claim 13, further comprising a step of repeating step a) for
2 second and subsequent images of the space and using each of the provided images.

1 18. The method of claim 13, wherein the modified image of the space is a
2 two-dimensional view of a three-dimensional geometric model, the method further comprising
3 a step of moving a camera position of the modified image of the space to simulate moving
4 around in the space.

1 19. The method of claim 13, wherein the step of prompting the user to identify
2 the product from a set of products is performed using a commerce server that serves product
3 models and further comprising a step of transmitting the digital image to the commerce server.

1 20. The method of claim 13, wherein the step of prompting the user to identify
2 the product from a set of products is performed using a commerce application that receives

3 product models and further comprising a step of providing the digital image to the commerce
4 application.

1 21. The method of claim 13, wherein the camera parameters include camera
2 position, camera rotation, focal length and center of projection.

1 22. The method of claim 13, wherein the reference information includes
2 correspondences between two-dimensional image features and three-dimensional structures.

1 23. The method of claim 13, wherein the step of determining the at least one
2 dimension reference is a step of inputting the at least one dimension reference, wherein a
3 dimension reference is a measurement of a distance in the space corresponding to a separation
4 of two points on the digital image.

1 24. The method of claim 13, wherein the step of determining the at least one
2 dimension reference is a step of assuming a default scale and using the default scale to
3 determine the at least one dimension reference.

1 25. The method of claim 13, wherein the three-dimensional model for a product
2 is a planar representation of an object and a texture map to be applied to a surface of the object.

1 26. A commerce server for generating remote presentations of products in situ
2 comprising:

3 product image storage for storing product representations, wherein a product

4 representation is at least a product image taken of a three-dimensional product;

5 means for receiving at least one digital image of a space in which a product is to be
6 viewed in situ;

7 space image storage for storing the at least one digital image of the space;

8 parameter storage for storing at least one dimension reference, wherein a dimension

9 reference is a measurement of a distance in the space represented as a line segment on
10 the digital image;

11 a photogrammetric modeling engine having inputs to receive an image and geometric
12 primitives mapping from the space onto the image and having an output to output the
13 camera parameters of a camera in the space with which the image was captured;
14 means for receiving an indication from a client identifying one or more product from a set
15 of products from the product image storage;
16 inputs for receiving one or more product location, a product location being a location in
17 the space where the product is to be in situ;
18 a visual reconstruction engine having an input to receive the digital image of the space
19 from the space image storage, an input to receive camera parameters for the digital
20 image from the photogrammetric modeling engine, an input to receive one or more
21 product representation for selected products as indicated by the means for receiving
22 an indication, and an output for outputting a geometric model of elements of the space
23 including the selected products; and
24 a renderer for rendering a combination of geometric models of the one or more product
25 and the space, using a set of camera parameters common to each.

1 27. An apparatus for generating a three-dimensional geometric model from at
2 least one two-dimensional image of a three-dimensional space having objects therein, the
3 apparatus comprising:

4 a photogrammetry engine with an image input for accepting the at least one
5 two-dimensional image and a primitives output for outputting primitives and
6 parameters that describe geometric elements of the objects in the image; and
7 a solid modeler with a primitives input for inputting primitives and parameters output by
8 the photogrammetry engine and a model output for outputting the geometric model,
9 wherein the solid modeler further includes means for modeling an object in the space
10 with a primitive shape or a mathematical operation of more than one primitive shape.

1 28. A method for generating presentations of products in situ, wherein an in
2 situ presentation includes a composite image showing one or more products in a space, the
3 method comprising the steps of:

- 4 a) inputting a scene digital image of the space, wherein the scene digital image is an image
5 of the space captured by an image capture device positioned in the space at a capture
6 position and having a capture focal length;
- 7 b) calculating, from the image, capture parameters for the image capture device in the
8 space, wherein the capture parameters include at least a representation of the capture
9 position and a representation of the capture focal length;
- 10 c) inputting a product representation that represents a product being considered for
11 placement in the space;
- 12 e) accepting an input of a product location, the product location being a location in the
13 space at which the product is being considered;
- 14 f) transforming at least one of the scene digital image and the product representation
15 wherein a transformed image is an image transformed according to the image's
16 associated capture parameters; and
- 17 g) combining the scene digital image and the product representation, as transformed in the
18 step of transforming, to form a combined image of the space where the combined
19 image shows the product in situ in the scene in the combined image with a proper
20 proportion and perspective.

1 29. The method of claim 28, wherein the product representation includes a
2 texture map associated with the product.

1 30. The method of claim 28, wherein the product representation includes at
2 least a product digital image, captured by a product image capture device positioned to capture
3 a digital image of the product.

1 31. The method of claim 30, wherein the product representation includes a
2 capture position, capture angle of rotation and focal length.

1 32. The method of claim 30, wherein the product representation includes
2 product image capture parameters including at least a representation of the position of the
3 product image capture device when the digital image of the product was captured.

1 33. The method of claim 32, wherein the product image capture parameters
2 include projections of geometric elements from the product onto the product digital image.

1 34. The method of claim 28, wherein the capture parameters for the image of
2 the scene include projections of geometric elements from the scene onto the scene digital
3 image.

1 35. The method of claim 28, wherein the capture parameters for the image of
2 the scene include an angle of rotation for the image capture device in the space.

1 36. The method of claim 28, wherein the step of inputting a product
2 representation is preceded by the steps of:
3 capturing a product digital image using the product image capture device; and
4 calculating, from the product digital image, product image capture parameters that include
5 at least a representation of the product image capture position and a representation of
6 the product image capture focal length.

1 37. The method of claim 28, wherein the step of transforming results in the one
2 or more transformed digital images sharing common capture parameters, the common capture
3 parameters including at least a capture position.

1 38. The method of claim 28, further comprising a step of prompting the user to
2 identify the product from a set of products for which a three-dimensional geometric model
3 exists or can be created.

1 39. The method of claim 28, further comprising a step of inputting at least one
2 dimension reference for one or both of the scene digital image and the product representation,
3 wherein a dimension reference is a measurement of a distance in space corresponding to a
4 separation of two points on the digital image or representation with which the dimension
5 reference is associated.

1 40. The method of claim 28, further comprising the step of repeating the step of
2 combining to form a further combined image of the space and a plurality of products, where
3 the further combined image shows the plurality of products in situ in the scene with each
4 product having a proper proportion and perspective.

1 41. The method of claim 28, wherein the step of inputting a product
2 representation is followed by a step of calculating, from the product digital image, product
3 image capture parameters that include at least a representation of the product image capture
4 position and a representation of the product image capture focal length.

1 42. A method for generating a combined image that simulates a product being
2 positioned at a location where a consumer is considering placing the product, without
3 physically placing the product at the location, the method comprising the steps of:

- 4 a) prompting the consumer to acquire a digital image of the location;
5 b) generating a location representation of the location and geometric elements representing
6 items at the location visible in the digital image of the location;
7 c) prompting the consumer to select a product from among a plurality of products;
8 d) retrieving a product representation for a selected product, wherein the product
9 representation includes at least a digital image of the product and a representation of
10 the position of a product image capture device when the digital image of the product
11 was captured.

1 43. The method of claim 42, wherein the location representation includes
2 location capture parameters of a location capture device, wherein the location capture
3 parameters include at least a representation of a position of the location capture device.

- 1 44. The method of claim 42, further comprising the steps of:
2 e) prompting the consumer to indicate where, at the location, the product is to be
3 considered; and

4 f) combining the location representation and the product representation after transforming
5 at least one of the representations to form the combined image showing the product in
6 situ with a proper proportion and perspective.

1 45. The method of claim 42, wherein the product representation includes at
2 least a three-dimensional geometric model and a texture map.

1 46. The method of claim 42, wherein the method is performed by a commerce
2 server and a consumer computer, the method further comprising the steps of:

- 3 e) sending a commerce application from the commerce server to the consumer computer;
4 f) executing the commerce application on the consumer computer, wherein the commerce
5 application performs steps a) and c);
6 g) using the commerce application to model geometric elements visible in the digital
7 image of the location; and
8 h) generating capture parameters for the digital image of the location from the geometric
9 elements using the commerce application, the capture parameters including a capture
10 location and a focal length.

1 47. The method of claim 42, wherein the method is performed by a commerce
2 server and a consumer computer and wherein the step of retrieving the product representations
3 is a step of retrieving the product representations from the commerce server.

1 48. The method of claim 42, wherein the method is performed by a commerce
2 server and a consumer computer and wherein the step of retrieving the product representations
3 is a step of retrieving the product representations from a product representation server.

1 49. A method of combining a plurality of two-dimensional images of
2 three-dimensional spaces into a combined image, comprising the steps of:
3 receiving the plurality of two-dimensional images;
4 using a photogrammetry engine to identify primitives and parameters that describe
5 geometric elements of the objects in the plurality of two-dimensional images;

6 identifying common objects common to more than one of the plurality of two-dimensional
7 images;
8 determining camera models such that the common objects are substantially coincident in a
9 common image plane, thereby forming a combined geometric model; and
10 generating an image of the combined geometric model.

1 50. The method of claim 49, further comprising a step of using a solid modeler
2 with a primitives input to generate a geometric model for each two-dimensional image from
3 primitives and parameters output by the photogrammetry engine.

1 51. A commerce application for generating remote presentations of products in
2 situ, using a client-server system, the commerce application comprising:
3 means for receiving product representations, wherein a product representation is at least a
4 product image taken of a three-dimensional product;
5 means for receiving a space representation comprising at least one digital image of a space
6 in which a product is to be viewed in situ;
7 space representation storage for storing the space representation;
8 parameter storage for storing at least one dimension reference, wherein a dimension
9 reference is a measurement of a distance in the space represented as a line segment on
10 the digital image;
11 a photogrammetric modeling engine having inputs to receive an image and geometric
12 primitives mapping from the space onto the image and having an output to output the
13 camera parameters of a camera in the space with which the image was captured;
14 inputs for receiving one or more product location, a product location being a location in
15 the space where the product is to be in situ;
16 a visual reconstruction engine having an input to receive the digital image of the space
17 from the space representation storage, an input to receive camera parameters for the
18 digital image from the photogrammetric modeling engine, an input to receive one or
19 more product representation for selected products as indicated by the means for
20 receiving an indication, and an output for outputting a geometric model of elements of
21 the space including the selected products; and

22 a renderer for rendering a combination of geometric models of the one or more product
23 and the space, using a set of camera parameters common to each.

1 52. The commerce application of claim 51, wherein the means for receiving
2 selected product representations comprises:
3 means for receiving an indication from a client identifying one or more product from a set
4 of products; and
5 means for retrieving selected product representations from a product representation
6 storage.

1 53. The commerce application of claim 51 comprising:
2 a client system including the space representation storage, the parameter storage, the
3 photogrammetric modeling engine, the visual reconstruction engine and the renderer;
4 and
5 a server system including the product representation storage.

1 54. The commerce application of claim 51 comprising:
2 a client system including the space representation storage, the parameter storage and the
3 renderer; and
4 a server system including the product representation storage, the photogrammetric
5 modeling engine, and the visual reconstruction engine.

1 55. The commerce application of claim 51 comprising:
2 a client system including the space representation storage and the parameter storage; and
3 a server system including the product representation storage, the photogrammetric
4 modeling engine, the visual reconstruction engine and the renderer.

1 56. The commerce application of claim 51 comprising a server system
2 including the space representation storage and the photogrammetric modeling engine.

1 57. A method of generating an image of a simulated space, wherein the space is
2 simulated in that it shows an object placed in a scene, where the object is a physical object and
3 the scene is a physical location, the method comprising the steps of:

4 acquiring one or more images of the scene, wherein the scene does not contain, at the time
5 of acquisition, the object at a desired object location in the scene;

6 generating a scene representation that includes a model of an image acquisition device that
7 captured at least one of the one or more scene images acquired in the step of acquiring
8 one or more images of the scene, the model including at least a representation of a
9 position of the image acquisition device in a space containing the at least scene image
10 when the at least one scene image was captured;

11 acquiring an object representation of the object that is to be simulated in the scene, where
12 the object representation is at least an image of the object; and

13 combining the scene representation and the object representation to form the image of the
14 simulated space.

1 58. The method of claim 57, wherein the object representation includes an
2 image taken from an image capture device.

1 59. The method of claim 57, wherein the object representation includes a
2 texture map.

1 60. The method of claim 57, further comprising a step of obscuring a portion of
2 the scene with the object where the object representation is constrained such that the
3 positioning or size of the object image is dependent on the positioning or size of an object
4 present in the scene.

1 61. The method of claim 60, wherein the object representation comprises an
2 object image and a geometric model where the geometric model of the object corresponds to a
3 geometric model of an existing object in the scene and the simulated space is a simulation of
4 the replacement of the existing object with the object represented by the object
5 representation.--